Space Weather Technical Forecast

Issued on Monday 17 February 2025 at 13:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares likely. Active electron fluence, potentially easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with the peak flare C6.1 at 16/1838 UTC from AR3998 in the southeast. There are twelve regions currently on the visible disc, however these are all relatively small and simple. The most complex are AR3990, just west of south-centre disc and AR3992, now approaching the west limb, however these have remained relatively stable. The most significant growth has been in the east disc, with the development of AR3997 and AR3999 in the northeast and AR3998 and AR3996 in the southeast. However, any growth has been relatively limited.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE and DSCOVER at L1, showed a waning connection to a fast wind from CH15/-. Wind speeds were elevated, but easing, from around 550 km/s to around 500km/s. Density was around average. Total Interplanetary Magnetic Field, Bt, remained weak throughout at 4-7nT with its north-south component also weak and variable in direction, between +7/-6nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at background levels. High energy electron flux (greater than 2MeV) at GOES16 was Moderate to High, peaking at 3930pfu at 16/1640UTC. The associated 24-hour fluence rose above the Active threshold (1e8 integrated pfu), with the 17/0000UTC observation being 1.19e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate, with isolated M-class flares likely.

Solar Wind / Geomagnetic Activity: There are no CMEs currently assessed as Earth-directed, however a couple of weak ejections from 14-15 Feb may pass nearby, with glancing influences possible day 1-2 (17-18 Feb). Otherwise, Elevated solar winds are expected to gradually ease to near Background as the influence of CH15/- wanes. Geomagnetic activity will be Quiet to Unsettled at first with a chance of Active intervals, and a slight chance of G1 Minor Storms, if any CME arrival occurs. This easing to be mainly Quiet with isolated Unsettled intervals by day 3 (19 Feb).

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Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background. High energy flux is expected to persist Moderate to High, however, current observations are lower than during the previous 24 hours. There is also the slight chance of flux dropping to background with any glancing CME influence day 1-2 (17-18 Feb). The persistence of any associated 24 hour Active Fluence is lower confidence due to this. Consequently this has a chance of falling below this level into day 2 (18 Feb), with a lowering chance of persisting days 3-4 (19-20 Feb)

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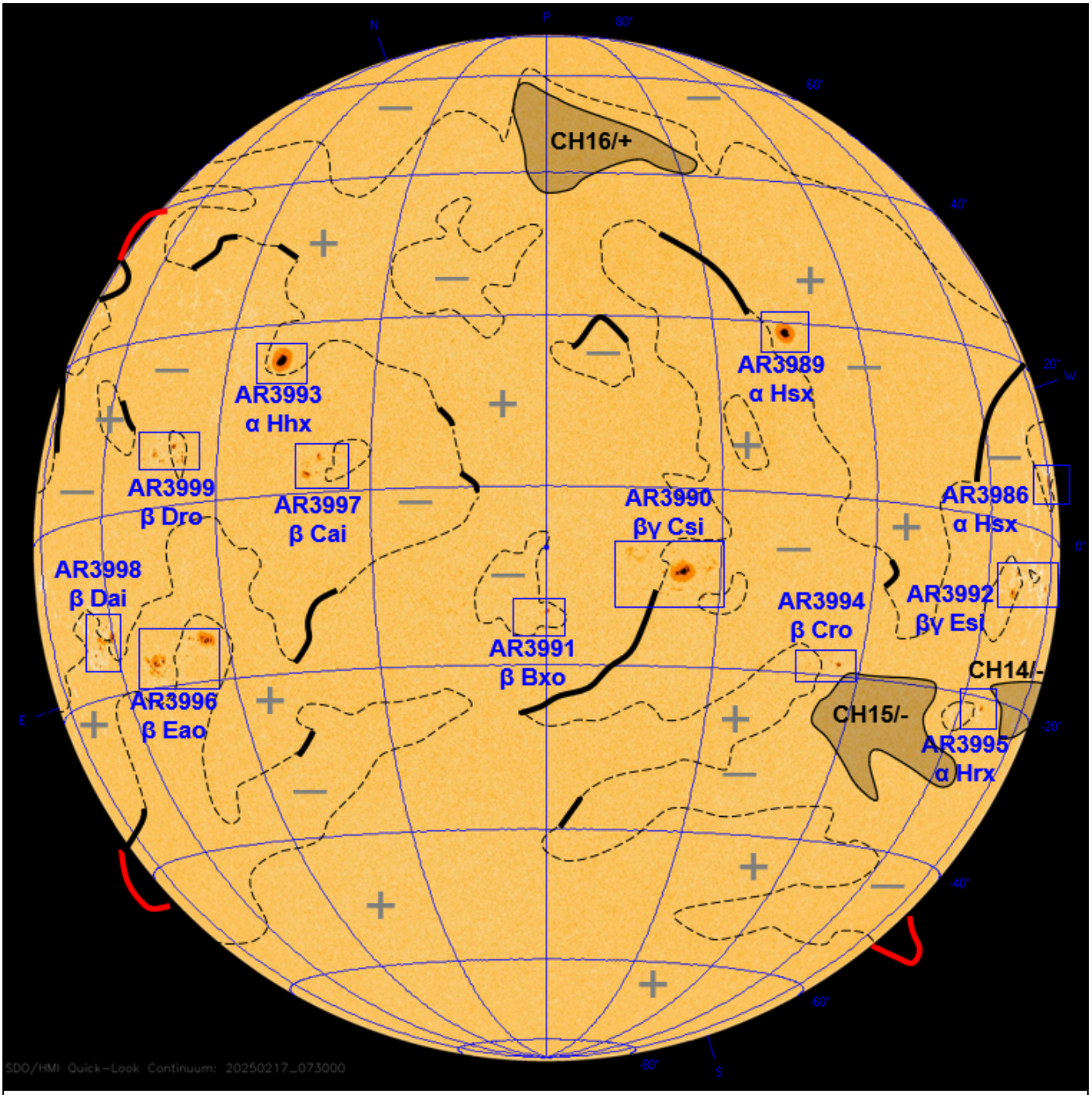
Figure 1: MOSWOC Solar Synoptic Map 17/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Several CMEs were observed leaving the Sun on February 14th and 15th, mostly originating from AR3990 or AR3994, and from a filament eruption. Confidence in all of CMEs is low, with limited coronagraph imagery for analysis and an apparent eastward deflection of the CMEs, likely due to CH15/-. However, these are currently expected to miss Earth, passing behind, with only a slight chance of glancing impacts on day 1-2 (17-18 Feb).

Otherwise, the ongoing fast wind conditions, now originating from CH15/-, is expected to to continue gradually easing from initially elevated, to likely near or at background by the end of the period. This is supported by MOSWOC Enlil.

Geomagnetic activity will be Quiet to Unsettled at first with a chance of Active intervals, and a slight chance of G1 Minor Storms, if any CME arrival occurs. This easing to be mainly Quiet with isolated Unsettled intervals by day 3 (19 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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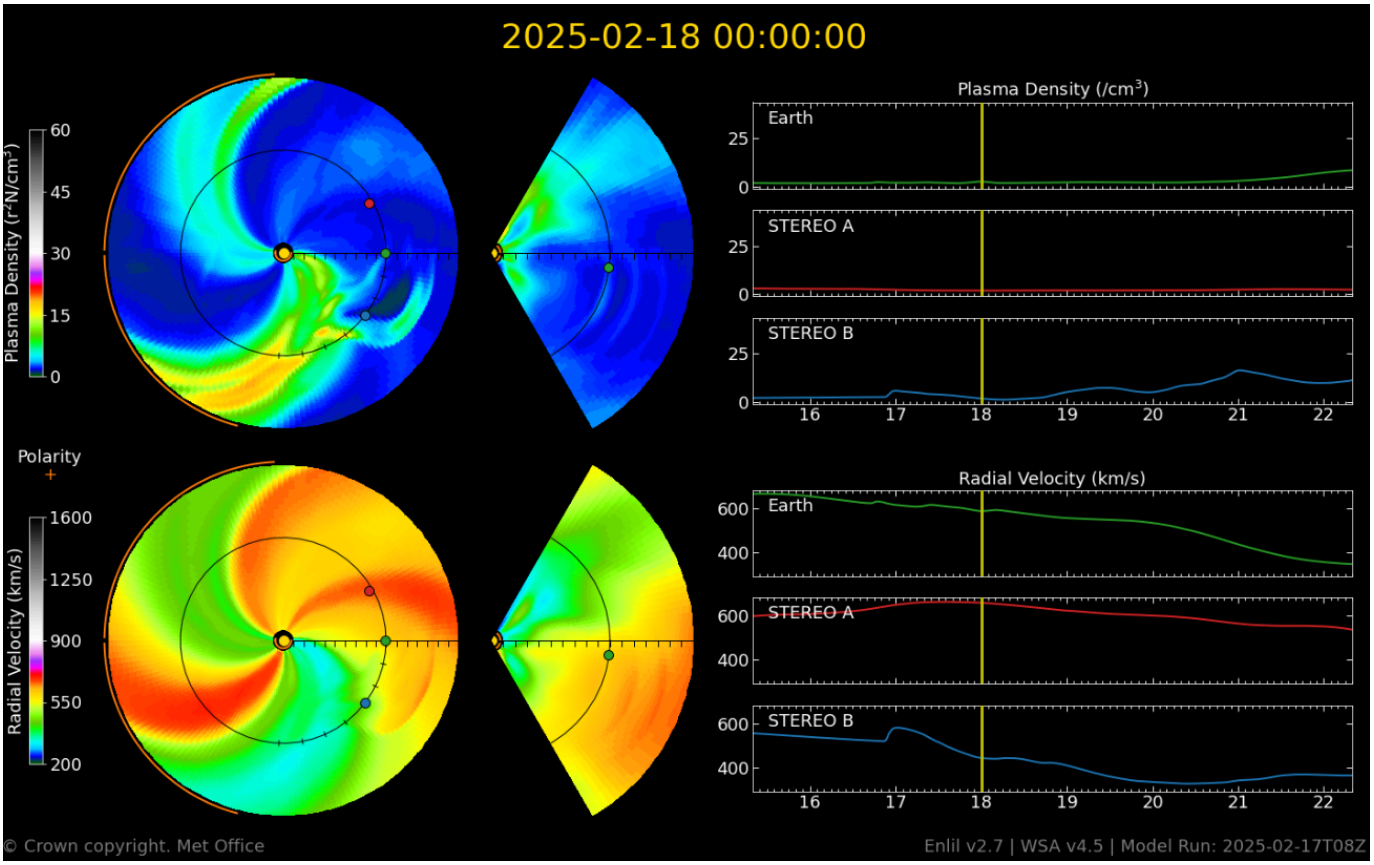
Figure 2: MOSWOC Enlil showing CMEs passing nearby, but likely missing. Otherwise, current fast winds gradually easing.



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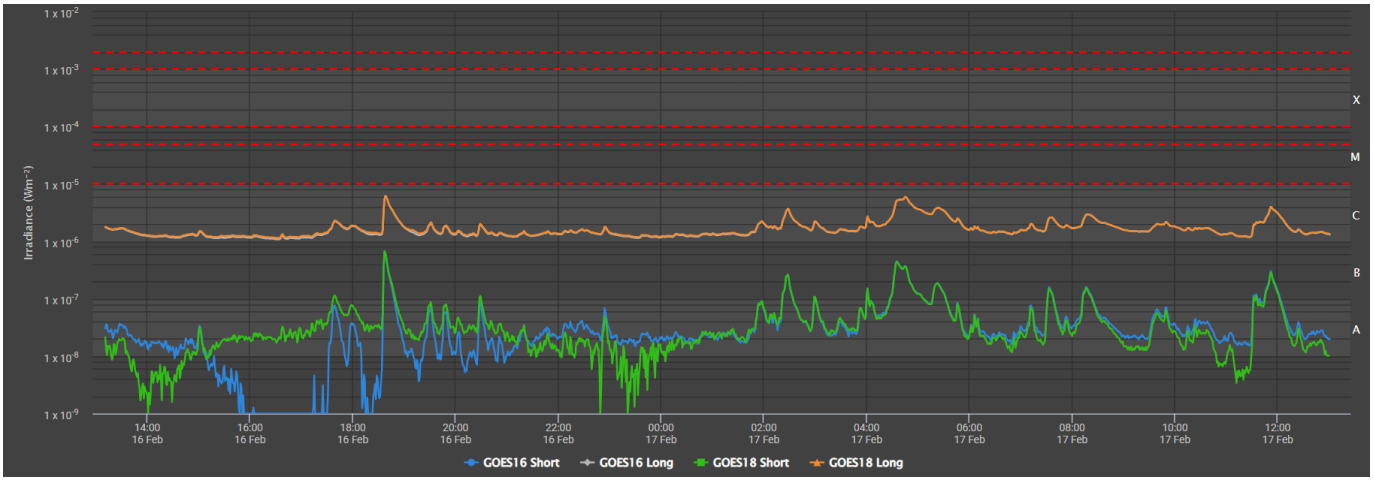
Radio Blackouts - X-Ray Flares

Low to Moderate activity is forecast, with an ongoing likelihood of isolated M-class flares.

There are twelve sunspot regions currently on the Earth-facing disc, although these are generally all small and relatively inactive. The most notable region is perhaps AR3990, now west of the south-centre disc, which has some slight magnetic complexity due to some mixed polarity surrounding spots and an attached filament to its southeast. AR3992 also exhibited some mixed polarity spots, however this is now difficult to assess as this moves close to the west limb, and is also predominately comprised of small spots. The main growth on the disc was from regions currently near the east limb, including AR3993 and AR3999 in the northeast, and AR3996 and AR3998 in the the southeast, however any development has been limited with these regions remaining magnetic simple.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	50	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES-16 X-ray Irradiance



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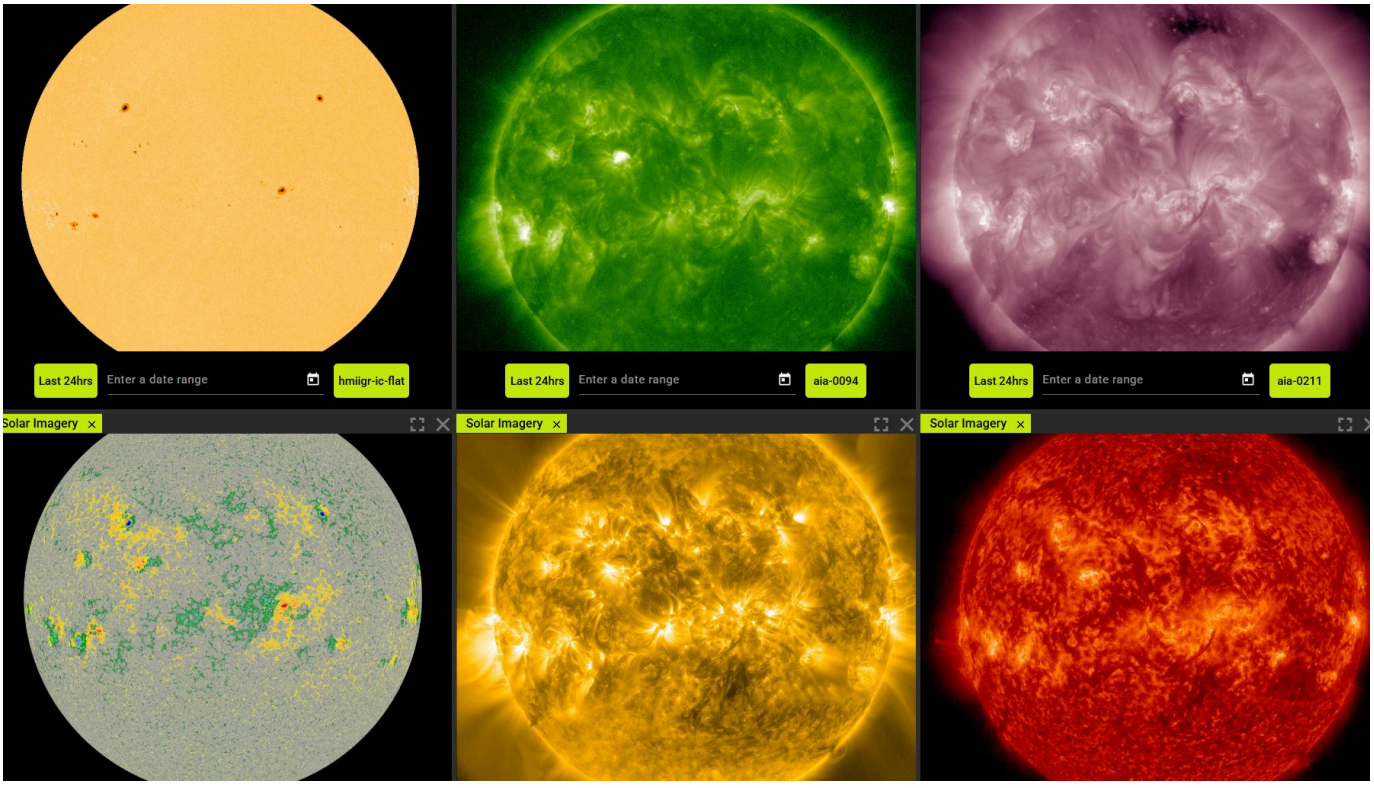
Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux is most likely to persist at background, but with a slowly increasing chance of enhancement due to any flaring from AR3990 as this region moves further across the better connected western hemisphere. Along with an increasing risk from AR3996 and AR3998, and other developing regions, as they move towards the centre disc, this brings a slight chance of the observed flux rising above the S1/Minor radiation storm threshold

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Current SDO imagery, showing a number of small spots, but limited complexity or activity



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High Energy Electrons (≥ 2MeV)

High energy electron flux, as observed at GOES-16 has been Moderate to High, likely due to the outward expansion to GEO of any charging to the Van Allen Belt that recently occurred from the connection to the fast wind of CH14/15. As solar winds continue to ease, this ongoing charged environment is expected to largely persist, although there are signs of of a decreasing trend with the current observations running lower than they were 24 hours previously. There is also a potential CME glace later on 17 or on 18 Feb, and while low confidence to occur, this could help to drop out the observed flux.

The associated 24 hour fluence is currently Active, at just over 1e8 integrated pfu. Confidence is now lower for this to persist into day 2 (18 Feb) due to the reduced flux levels early on day 1 (17 Feb). Alongside any potential flux drop out due to any glancing CME, this may allow for fluence to fall below Active, with a decreasing confidence for Active fluence by day 3-4 (19-20 Feb). Conversely MOSWOC REFM is currently indicating Active levels persisting, but is over-estimating the current fluence.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	Yes	100	60	30	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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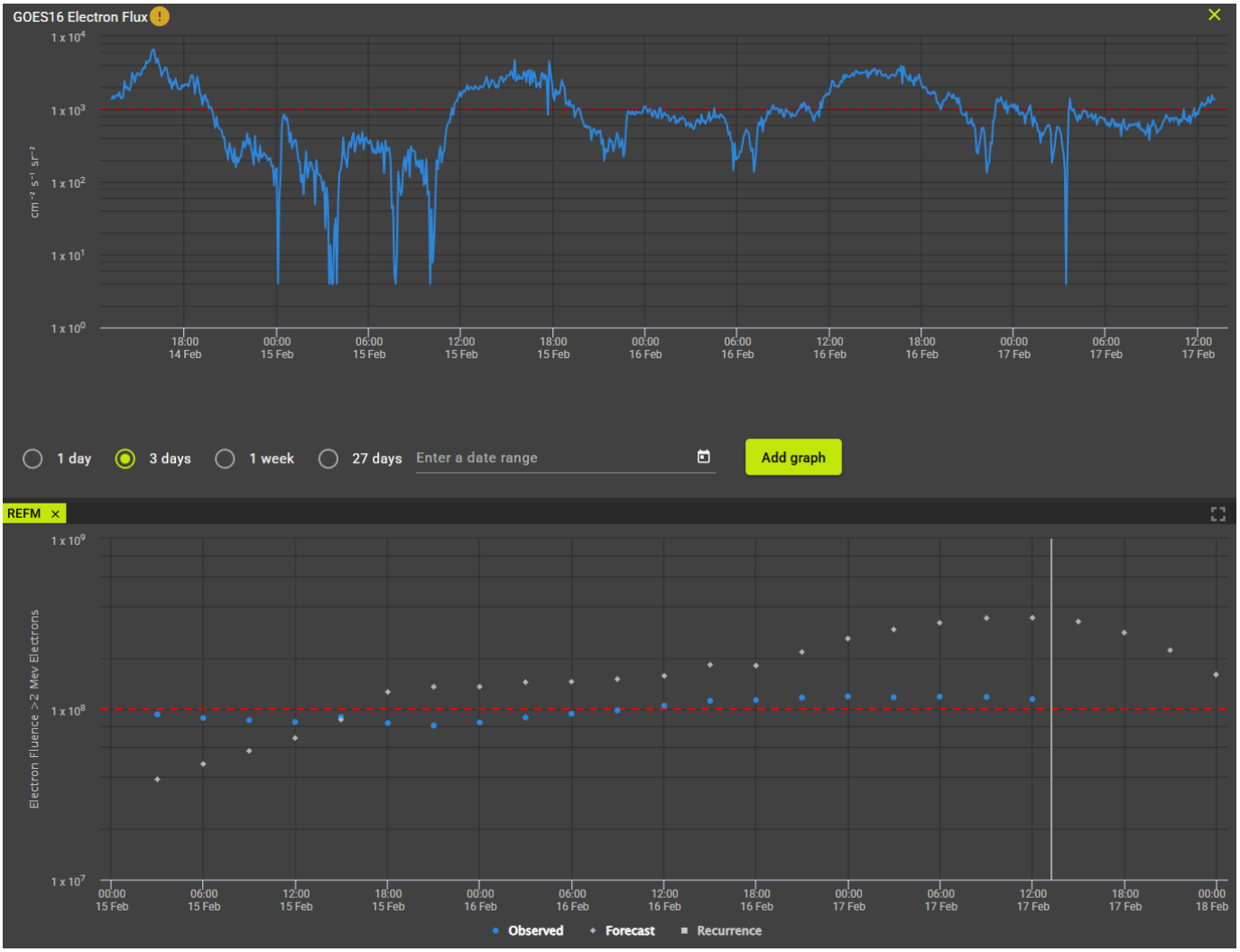
Figure 5: GOES16 >2MeV Flux (top) and associated Fluence with REFM. This shows current observations remaining below the previous 24 hours



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